SECTION 202 - PORTLAND CEMENT CONCRETE

1. GENERAL

Concrete shall consist of cement, coarse aggregate, fine aggregate, approved admixture, and water; proportioned and mixed to produce a workable mixture suitable for specific conditions of placement as noted in the following specifications.

All concrete used in the work shall be air-entrained unless otherwise permitted by these specifications or approved by the Engineer.

2. MATERIALS

A. Portland Cement.

1. General - Portland Cement shall conform to the requirements of ASTM Designation C150 and shall be Type I, Type II or Type III depending on the specified use of the material. All requirements of ASTM C150 shall be met, except for the following changes:

a. The "fineness" will be determined by the use of the Blaine Air Permeability Apparatus (ASTM C204). The fineness of Type II shall not exceed 400 m^2/kg nor be less than 280 m^2/kg.

b. The "time of set" will be determined by the use of the Gillmore test (ASTM C266).

c. The "total alkali" content (%NA_20 + 0.658 x %K_20) of Type II shall not exceed 0.60%.

Use of cements with interground admixtures will not be permitted without approval.

2. Uses - Type II Portland Cement may be used for construction of bridge decks (wearing course) and concrete pavement. Type III Portland Cement shall be used for early strength concrete. Type I and Type II cement may be furnished for all other types of concrete construction.

B. Aggregates. The use of pit run or naturally mixed aggregates will not be permitted. Fine and coarse aggregates shall be separately furnished and stored. The mixing of different kinds of aggregates from different sources or alternating batches of different aggregates in one stockpile will not be permitted. In no case shall aggregates containing lumps of frozen or partially cemented materials be used. Aggregates proposed for use in the work shall meet the following requirements. The fine and coarse aggregates must be well graded for concrete.

1. Deleterious Substance - Deleterious substances in aggregates shall not exceed the following percentages by weight when tested under the designated ASTM or KDOT method.

	Coarse	Fine	Test
Material Passing No. 200 Sieve	2.50	2.00	C117
Shale	0.50	1.00	KT-8
Soft Friable Pieces	2.50	0.50	KT-9
Sticks (wet)	0.10	0.10	
Coal	0.50	0.25	C123
Clay Lumps (wet, on No. 4 Sieve)	0.50	0.25	KT-7

No one of the above percentages shall be exceeded when taken separately. The combined percentage for shale, soft friable pieces and coal shall not exceed 1 percent. In addition, any combination of shale, soft friable pieces, sticks, coal or clay lumps shall not exceed 3 percent for course aggregates.

2. Coarse Aggregate- Coarse aggregate shall be hard, durable, clean uncoated pieces of crushed rock or gravel. Coarse aggregate will be well graded within the following limits (KDOT CA-4) when tested under Standard KDOT Specification 1102.

Sieve Size -----	3/4	1/2	3/8	4	8
% Retained ----	0	0-30	30-60	75-100	95-100

3. Fine Aggregate - Fine aggregate shall consist of clean, hard, durable, uncoated siliceous or calcareous particles well graded within the following limits.

Sieve Size -----	3/8	4	8	16	30	50	100
% Retained ----	0	0-5	0-24	5-50	40-75	70-90	90-100

The Fineness Modulus (F.M.) of the fine aggregate furnished shall be not less than 2.5 nor more than 3.4 when determined by using a sieve consisting of the No. 4, 8, 16, 30, 50 and 100 size. After acceptance of a gradation for use in the work the F.M. shall not vary more than + 0.2.

4. Stockpiles - Aggregates that have become mixed with earth or foreign material shall not be used.

5. Aggregate Tests

a. General - All aggregates shall be certified by a City approved Testing Laboratory as complying with the above requirements covering deleterious materials and gradation. In addition, unless waived by the City certified tests shall also be provided in accordance with Paragraphs b. thru d. below.

b. Soundness - Coarse aggregate for concrete when tested for soundness with magnesium sulphate in accordance with ASTM Standard C88 shall have a total loss not greater than 18% by weight.

c. Abrasion - The percentage of wear of the coarse aggregates by the Los Angeles Abrasion Test, ASTM C131.

d. Absorption - Coarse aggregate for concrete shall have a limit of 4% or less, as determined by ASTM C127.

C. Admixtures

1. General - Admixtures are defined by these specifications as a material, other than portland cement, aggregate or water, added to concrete to modify its properties. The following admixtures shall be used when required and may be used when permitted.

2. Air Entraining Agent (AEA) - An approved air entraining agent shall be used to produce 5 to 8% air entrainment in the concrete as placed. The AEA shall be a neutralized solution of vinsol resin meeting the requirements of ASTM C-260.

3. Calcium Chloride - When approved by the Engineer, calcium chloride meeting the requirements of ASTM D-98 may be used as an accelerator in an amount not exceeding two (2) percent of the weight of cement.

4. Water Reducing Admixture - At the option of the Engineer, a water reducing admixture (WRA) may be used composition described as "hydroxylated carboxylic acid" or "hydroxylated polymers" and shall meet the requirements of ASTM C494, Type A or Type D. Before approval, the compatibility of the proposed admixture, with the other materials to be used in the concrete mixture, shall be established by test.

D. Water. Water used in concrete shall be potable and approved for domestic use by the Department of Health and Environment. Water from other sources will be tested prior to acceptance for use.

3. PROPORTIONING.

A. Mix Design. Concrete mixes to be used in the work shall be proportioned in accordance with the requirements of Table 1. All materials shall be proportioned by weight considering one sack of cement as 94 pounds and one gallon of water as 8.33 pounds.

Concrete Class	Minimum 28-Day Strength (PSI) Compressive	Flexural	Minimum Cement Factor 94lb Bags/C.Y.	Air Entrain-ment	Maximum W/C Ratio Gal./Bag	Rock Content	Slump (in.)
Class I	4000	550	6.5	5-8%	5.5	27%	1 to 3
Class II	4000	550	6.0	5-8%	6.0	40%	1 to 3
Class III	5000	600	8.0	5-8%	4.50	30%	1 to 3

B. Concreting in Cold Weather or Night Concreting. Unless authorized by the Inspector, mixing and concreting operations shall be discontinued unless the ambient air temperature is 40 degrees Fahrenheit and rising. The temperature of the mixed concrete shall be not less than 50 degrees F. and not more than 90 degrees F. at the time of placing it in the forms. No concrete shall be placed on frozen subgrade nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, the Inspector may require that the aggregate and/or water be heated prior to mixing the concrete. Aggregates may be heated by either steam or dry heat but not by gas or oil flame or on sheet metal over fire.

When ambient temperature is anticipated to drop below 40º F. within the first seven (7) days of placement of the concrete, the contractor will protect with insulated blankets.